

One month of RIB@LNS



One month of RIB@LNS

 «For beam quality and technical professionalism LNS has nothing to envy to major international laboratories. »

 «Unfortunately for minor negligence the user could get the feeling that long and complex experiments cannot be successfully performed at LNS.»

 «We got a different feedback mainly because we were all the time sitting nearby the main accelerator control room.»

One month of RIB@LNS

One month FRIBS

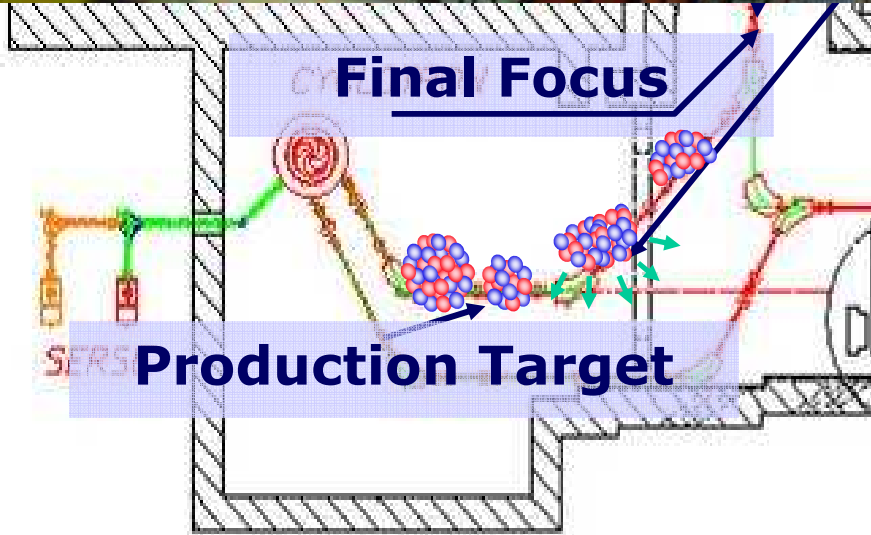
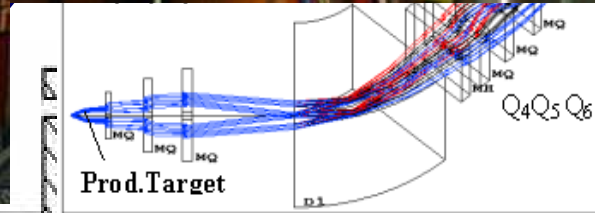
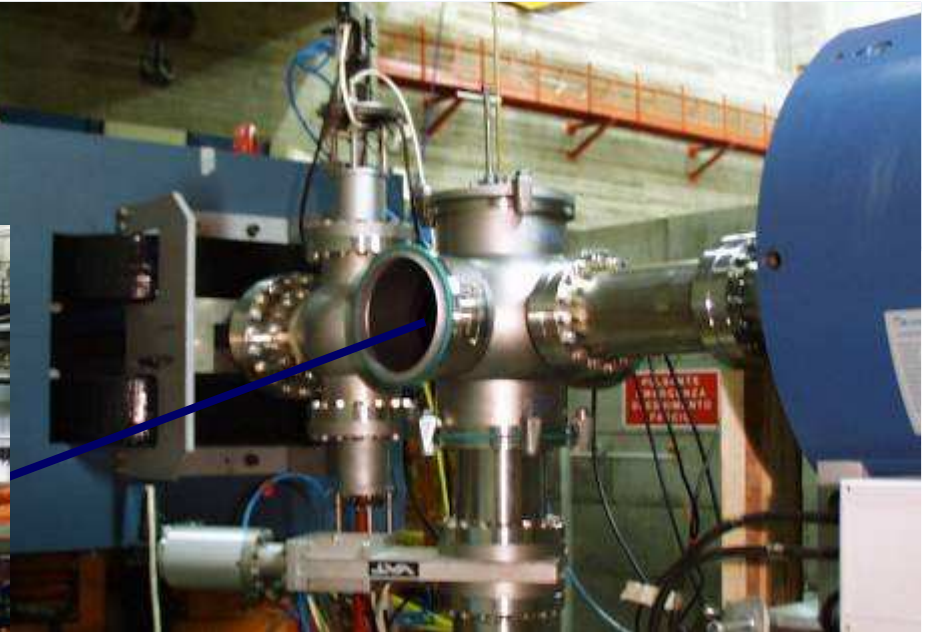
Facts and Achievements

Pure bad luck?

Behind the curtains

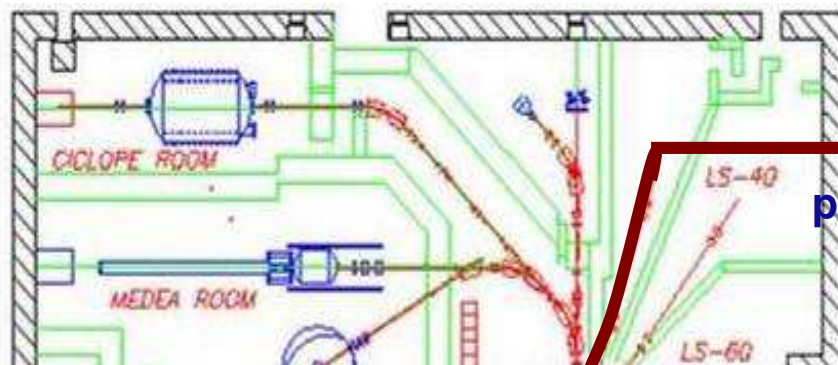
Suggestions to the UC

The FRIBS Project



One month FRIBS

The Experimental Setup

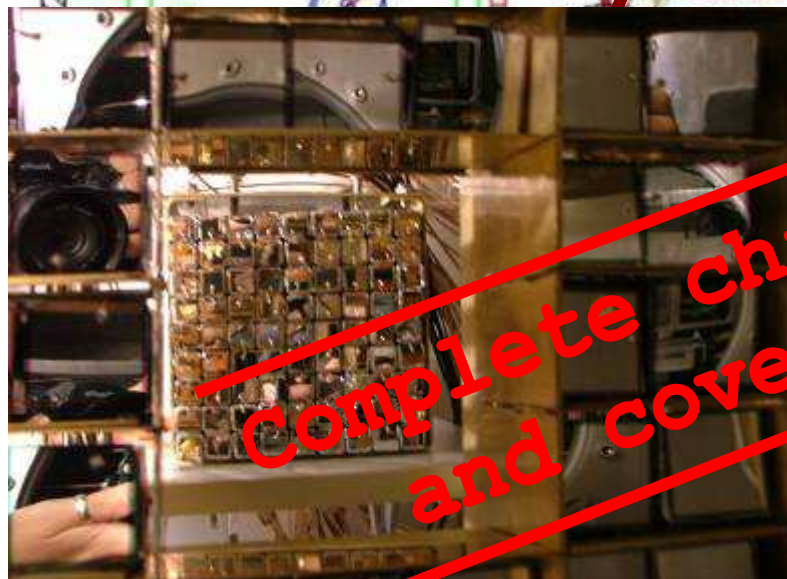


projectile fragment

Target

Hodo Big

Hodo Small



**HODO-SMALL: 81 two-folds
telescopes array $\pm 4.5^\circ$ - $\pm 4.5^\circ$
Si(300 μ m)-CsI(10cm)**

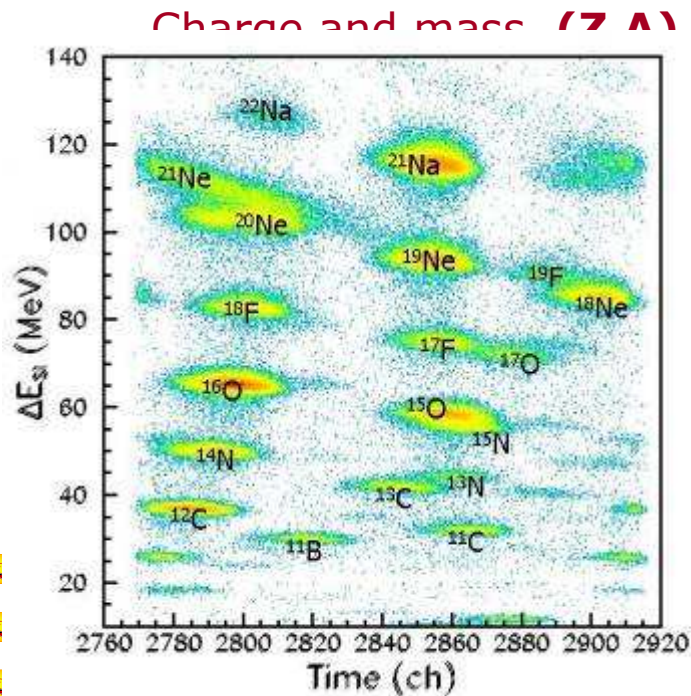
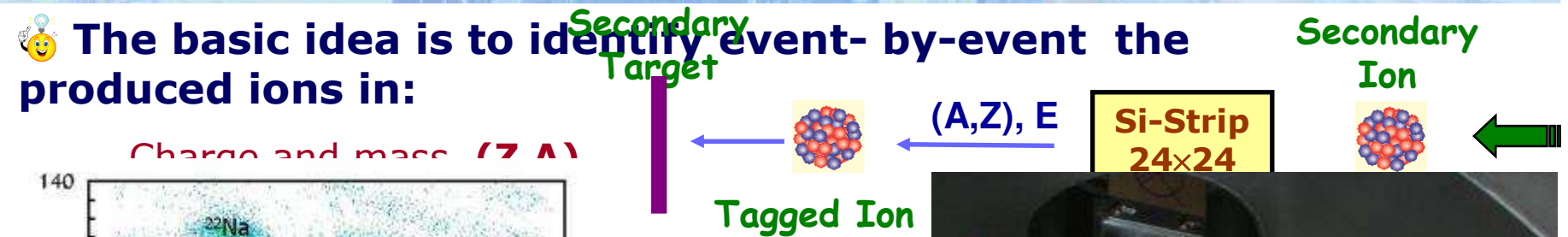


**HODO-BIG: 89 three-folds
telescopes array $\pm 4.5^\circ$ - $\pm 16.5^\circ$
Si(50 μ m)-Si(300 μ m)-CsI(6cm)**

**Complete characterization
and coverage near 90%**

The Experimental Setup: tagging

The basic idea is to identify event- by-event the produced ions in:



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studies
n measurements
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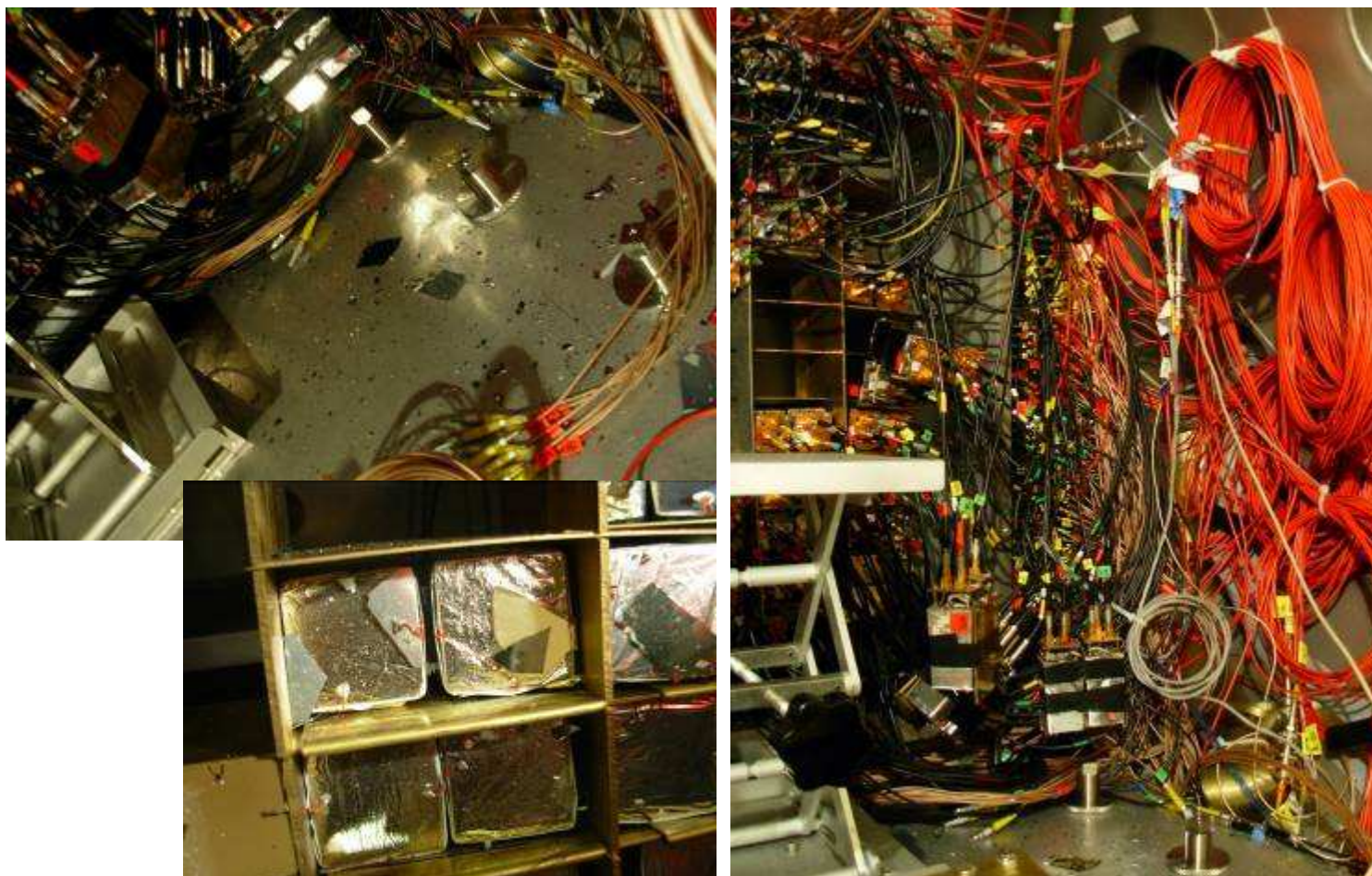
^{18}Ne , ^{17}F Production

- 300÷400 enA of primary beam current
- 60 kHz of secondary beam on the tagging detector
- ≈ 5 kHz of ^{18}Ne and ≈ 3 kHz of ^{17}F

One month FRIBS



FRIBS Ground Zero



7 April 2008

One month FRIBS

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Not accounted for in the «month»



One month FRIBS

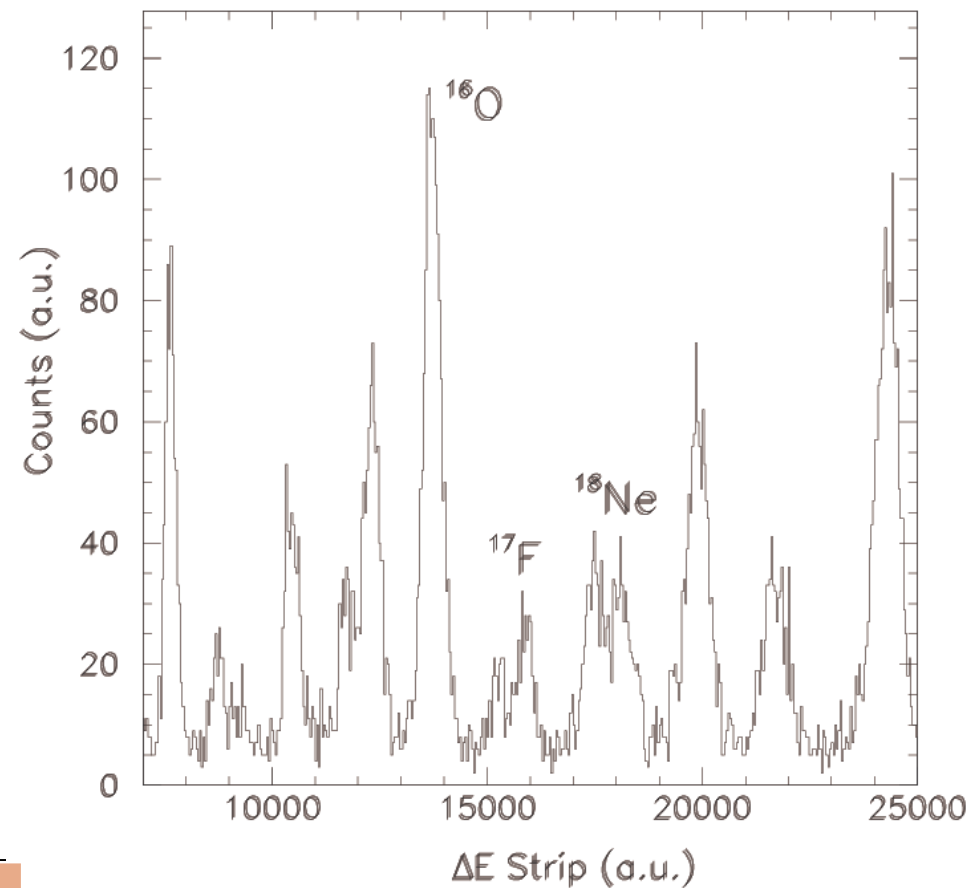
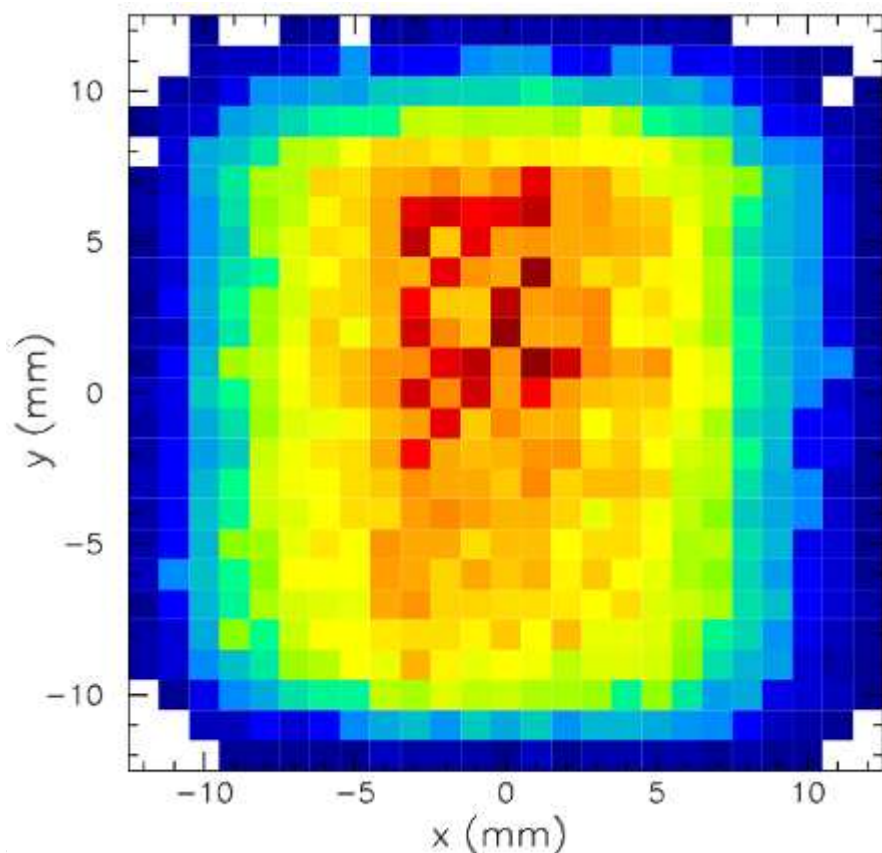
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Diproton Experiment (50 BTU)

DiP (May 2009) $^{18}\text{Ne} + \text{natPb}$ @ 40 A MeV

Systematic investigation of ^{18}Ne Diproton radioactivity

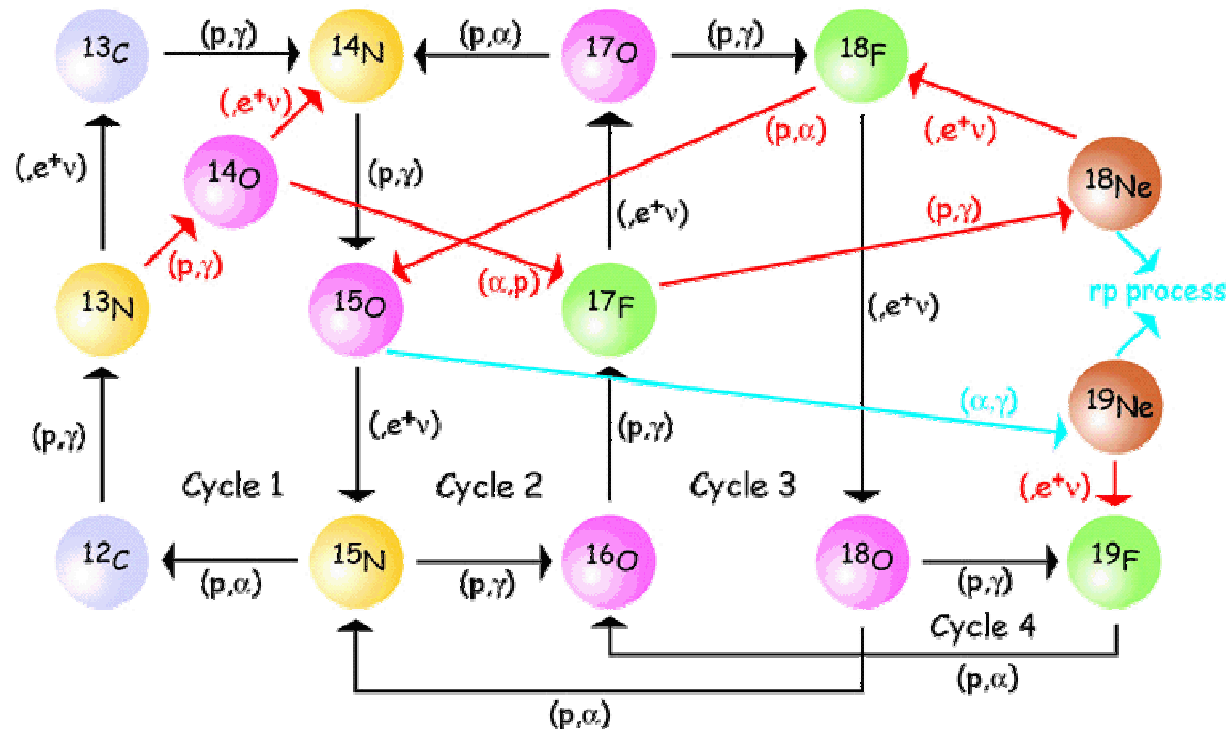


One month FRIBS

Flubber Experiment (40 BTU)

Flubber (June 2009) $^{17}\text{F} + ^{\text{nat}}\text{Pb}, ^{12}\text{C}$ @ 40 A MeV

Coulomb breakup in ^{17}F as an testcase for indirect measurements



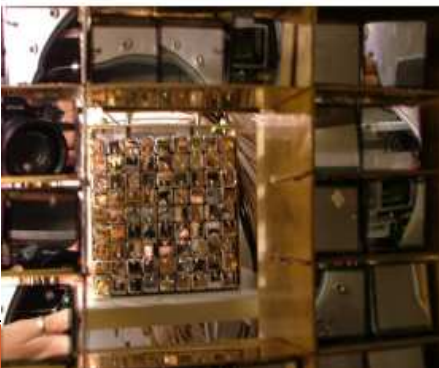
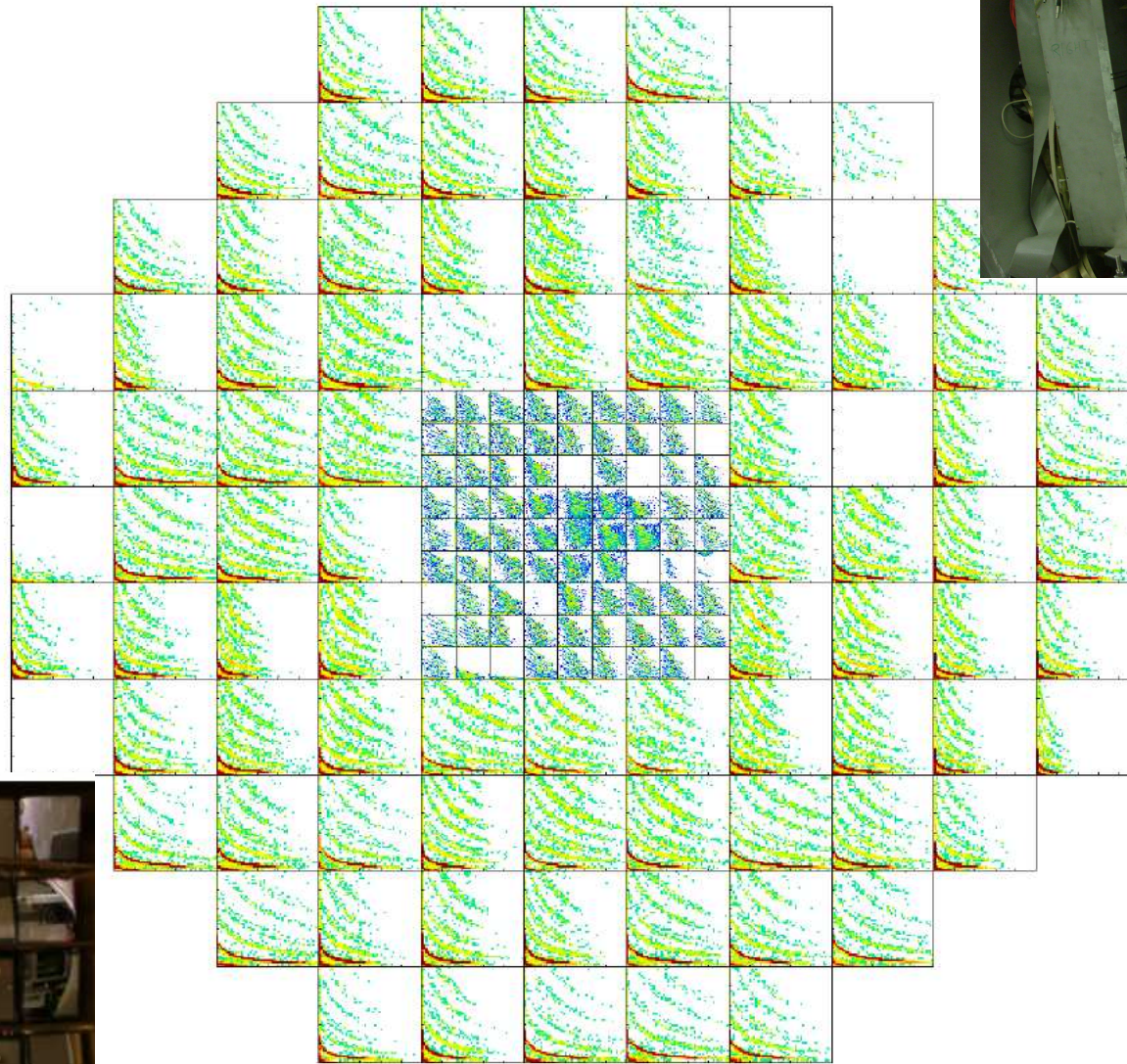
CNO: $T_9 < 0.2$

Hot CNO: $0.2 < T_9 < 0.5$

rp process: $T_9 > 0.5$



Performances



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More than facts

1. Preparation

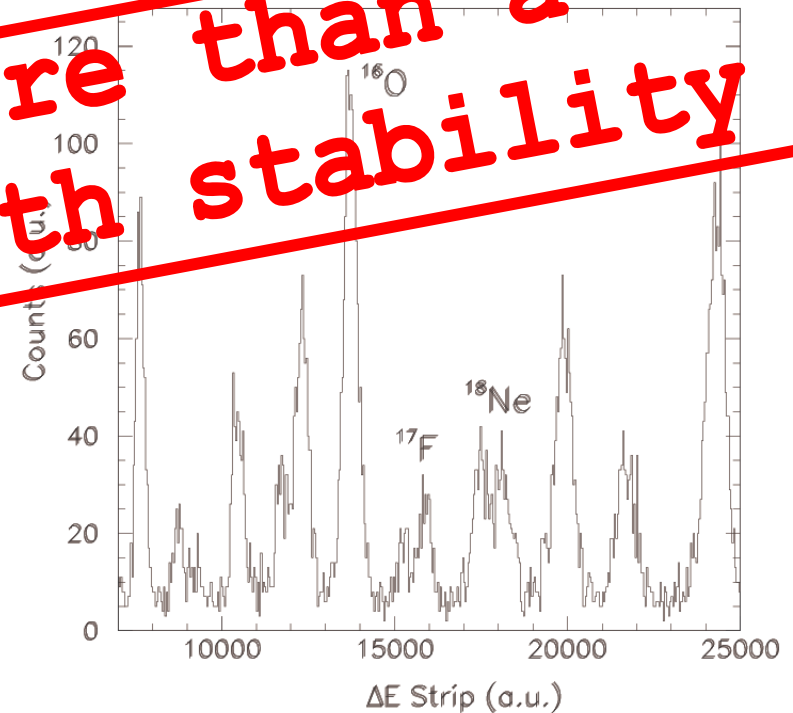
...from scratch BUT
beam well known

Scheduled

MON 4 h. 08	Preparation	
TUE 5 h. 22	DI-PROTON	CARDELLA RACITI

TUE 5 h. 14:00	^{20}Ne
h. 15:00	First Setting (^{18}Ne)
h. 17:00	Second Setting (^{17}F)
h. 19:00	Secondary Beam on TStrip

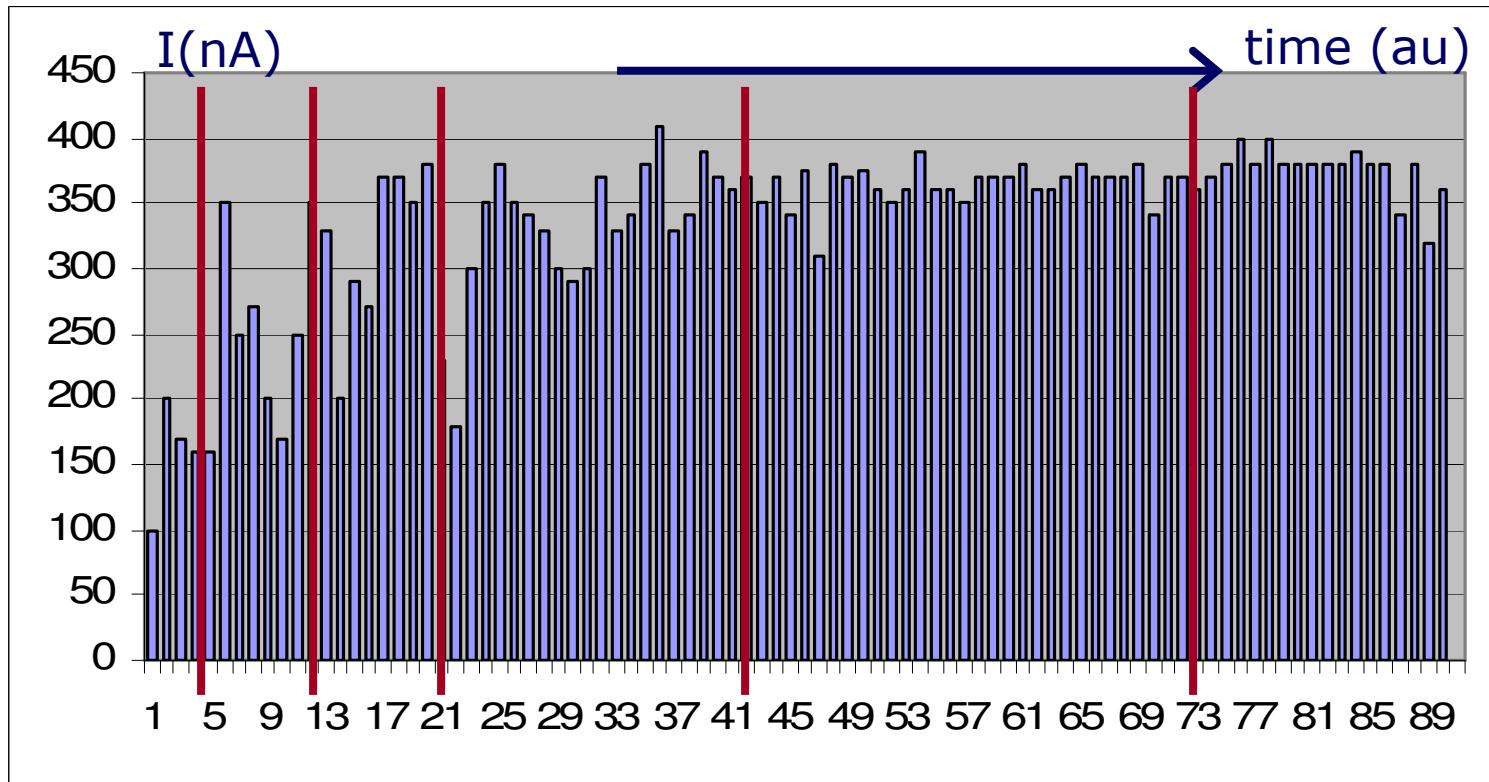
**More than a
month stability**



More than facts

2. Primary Beam Intensity

⌊ radioactive ion beam stability



More than facts

3. Coupler history...

...16.05 4:25am ...16.05 13:00

Diagnosis: **Leakage** in the
main accelerator chamber



ONLY 5 days
for:

**Open-
Dismount-
Repair-
Remount-
Reboot**

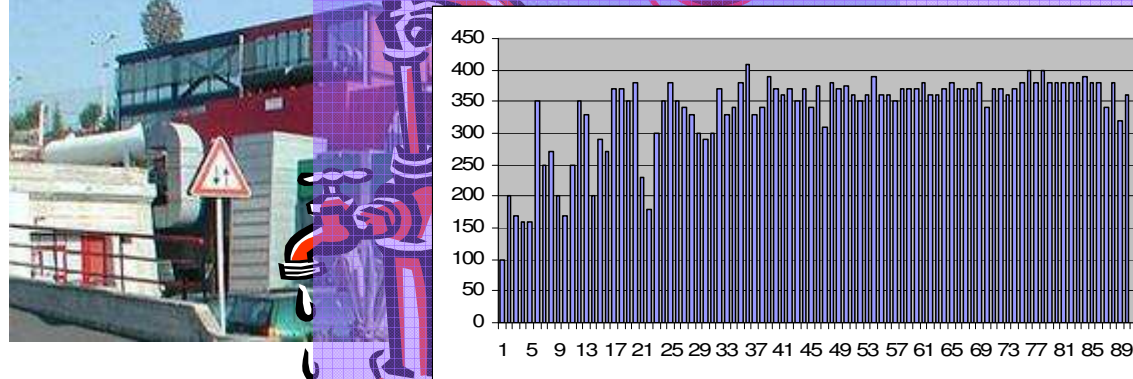
Also « facts »



6.05 13:50pm



12% BEAM TIME +
Power Failure: $\approx 10\text{h}$ + side effects
side effects
Water Failure: $\approx 8\text{h}$ + side effects
Ex: 4 days deflector



9.06 6:00am



Pure bad luck?

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Behind the curtains

🎯 «**We got a different feedback mainly because we were all the time sitting nearby the main accelerator control room.**»



...no beam!...



- 😬 **No power**
- 😬 **No water**
- 😬 **No Comp.-air**

Suggestions/Wishes



**Write an official statement as User Committee
about this UPS issues**

The Program Advisory Committee may also participate.



**Collect a detailed list of the different technical
lacks, which too often prevent a smooth running
condition**

**Submit it in some official form to the director and the technical
division head.**



**Ask also for advice from the accelerator division
people: they surely know more about underneath lacks
than any user can.**

LOI 4 FRIBS Upgrade: HUPPY

A bit of history....

What we did: DIProton

What we have to do: Maghy

What we would like to do....

The FRIBS Upgrade



Fragment Spectrometer

Table 1: Fragment Separators Main Parameters.

	$\Delta\Omega$ (mrad)	$\Delta P/P$ (%)	R_p	MaxBp (Tm)	Length (m)
FRIBs	4.0	+/- 1.1	800-1500	4.0	23
Present	1.1	+/- 0.65	1000	2.7	23
GANIL	1.0	+/- 2.5	800	3.2	18
GSI	0.7-2.5	+/- 1	240-1500	9-18	74
RIKEN	5.0	+/- 3	1500	5.76	21
NSCL	0.8-8	+/- 1.5	700-1500	5.4	22
JINR	6.4	+/- 1	4360	4.5	14.5

present experiment. Larger solid angle and momentum acceptance will be achieved by replacing the present quadrupoles with larger ones (FRIBs in Table1).



Tagging Detector

Higher Rate:

Silicon Strips with high-rate capabilities readout

... Other ideas under investigation

G. Raciti et al. Varenna 2003



Front-End Electronics

Multi-hit capabilities

Digital Front-End Electronics

The FRIBS μ Upgrade

A bit of history....

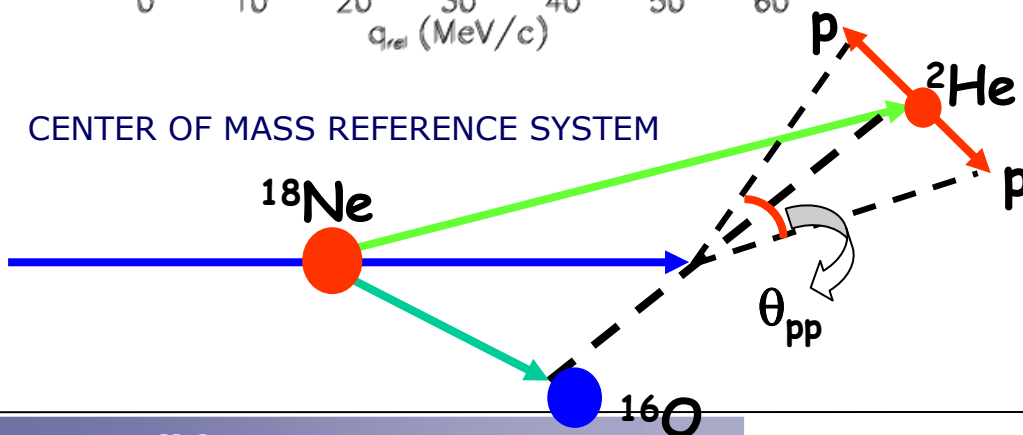
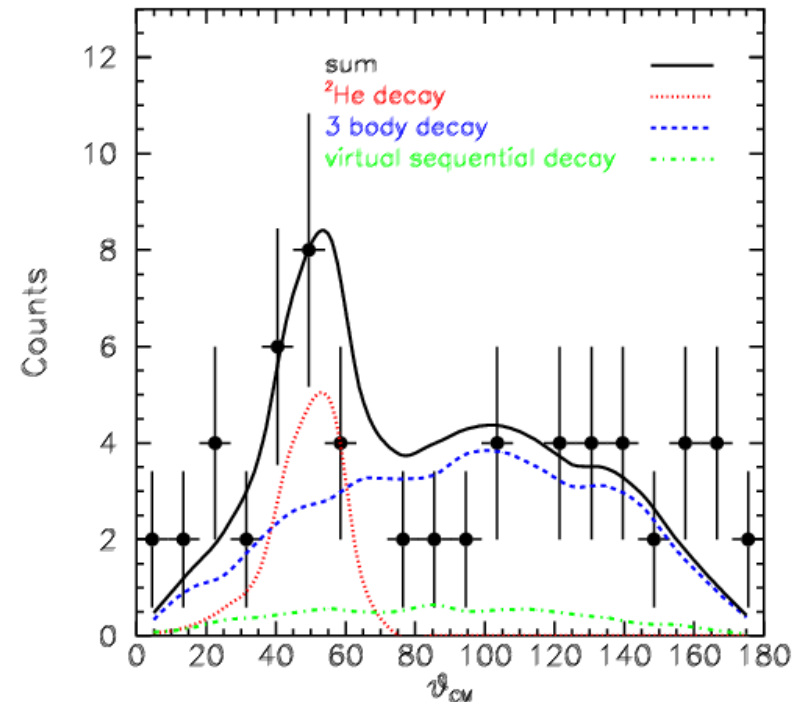
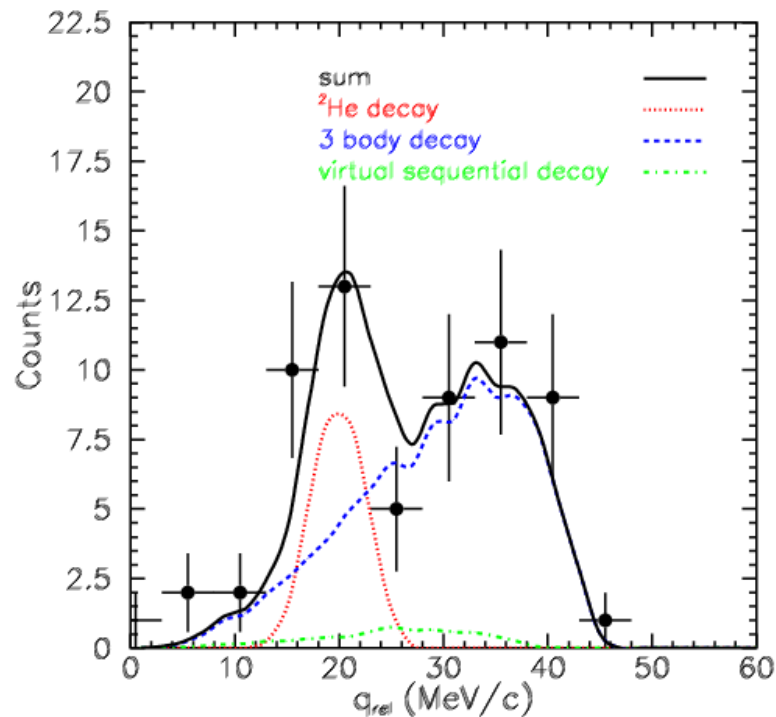


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Momentum and angle correlation for $E^* \approx 6.15 \text{ MeV}$

G. Raciti, et al., **Phys. Rev. Lett. 100, 192503(2008)**



(66±9)% direct three-body
(3±2)% virtual sequential
(31±7)% ^2He decay



Mg: the bottle neck

$^{18}\text{Ne}, ^{17}\text{F}$ Production



👉 **300÷400 enA of primary beam current**

👉 **60 kHz of secondary beam on the tagging detector**

👉 **≈ 5 kHz of ^{18}Ne and ≈ 3 kHz of ^{17}F**

CS Metal Beams History

Be without timing ≈ 40 nA

Ni/Sn/Au without timing ≈ 15 nA

Ni/Sn with timing ≈ 1 nA (requested from the user)

Ex:

@ Ganil: Mg ($1\mu\text{A}$) – Ni ($> 3\mu\text{A}$) – Sn ($0.2\mu\text{A}$)



Maghys Serial Tests

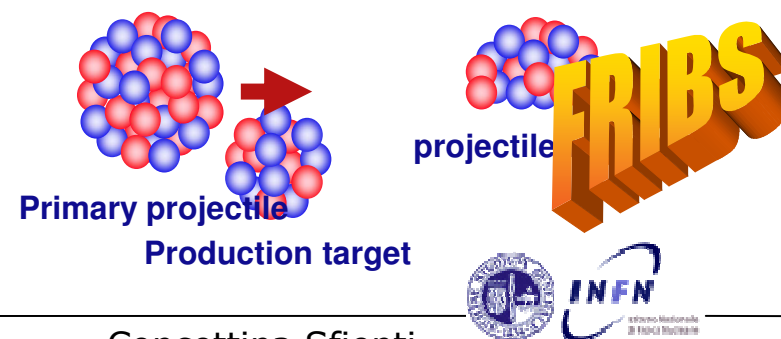
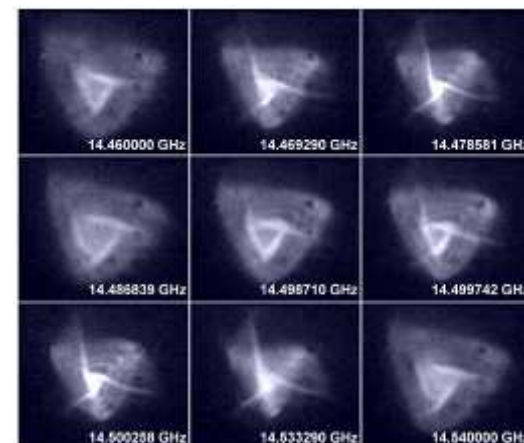
 *Implementation of frequency tuning, TCFH, phase correlation and plug-in effect @ SERSE*

 **$^{24}\text{Mg}@50\text{A MeV}$:** Beam transmission systematics, throughout the inflector and after the cyclotron, to be correlated with emittance measurements and ion source parameters.

 Cross comparison with **$^{20}\text{Ne}@50\text{A MeV}$**

 Production and transmission of ^{17}Ne

 Production and transmission of ^{20}Mg



What we have to do: Maghy (C-125)

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Beam Time Request

Beam	Energy (A MeV)	Intensity (pnA)	Beam line	BTU
^{20}Ne ^{24}Mg	50	>300 enA	FRIBS 20°	21



Simultaneous study of:

High intensity primary beam (cross-comparison Ne-Mg)

^{17}Ne production

FRIBS μ Upgrade: Si-Strip (thick,latency) + DAQ (minim. Dt)

New diagnostic detectors (MCP)

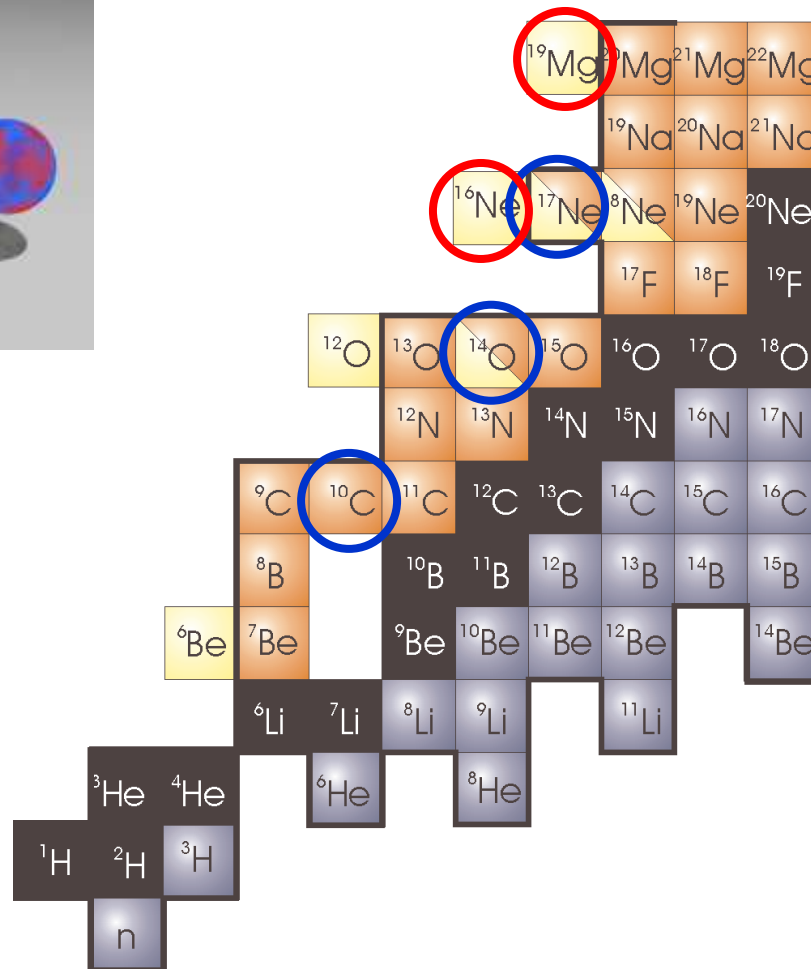
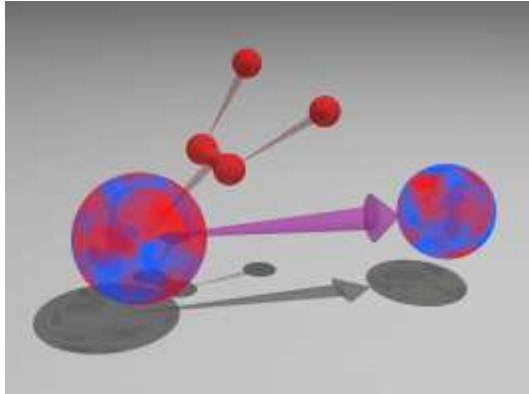


What we have to do: Maghy (C-125)

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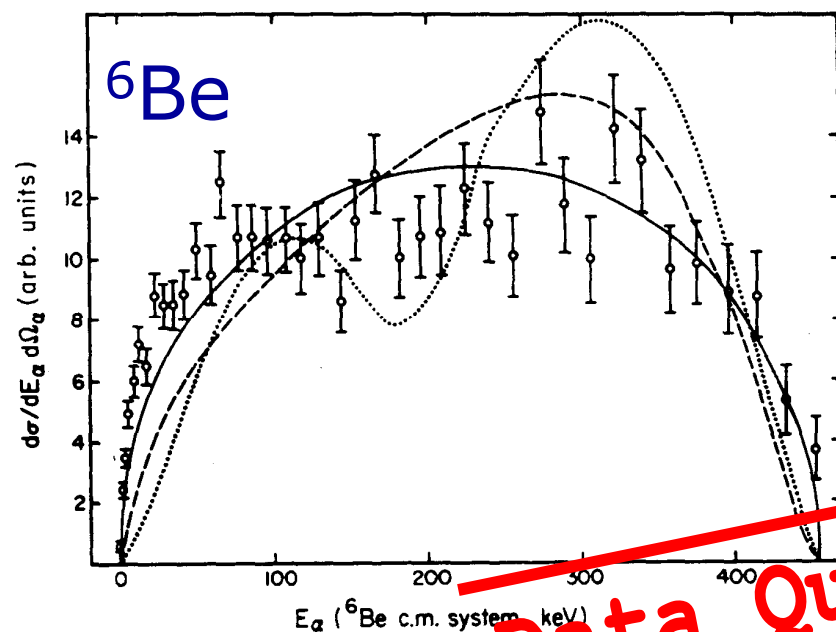
HUPPY: Hunting for PP DecaY



What we would like to do....

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HUPPY: Phase 1



D.F. Geesaman et al., Phys. Rev. C15 (1977) 1835

2p radioactivity in light nuclei

...their Conclusions:

- @ In light nuclei "Phase space wins": If it can decay sequential, it will
- @ Ground-state di-proton decay very unlikely

Data Quality Debatable
Need Confirmation

...our program:

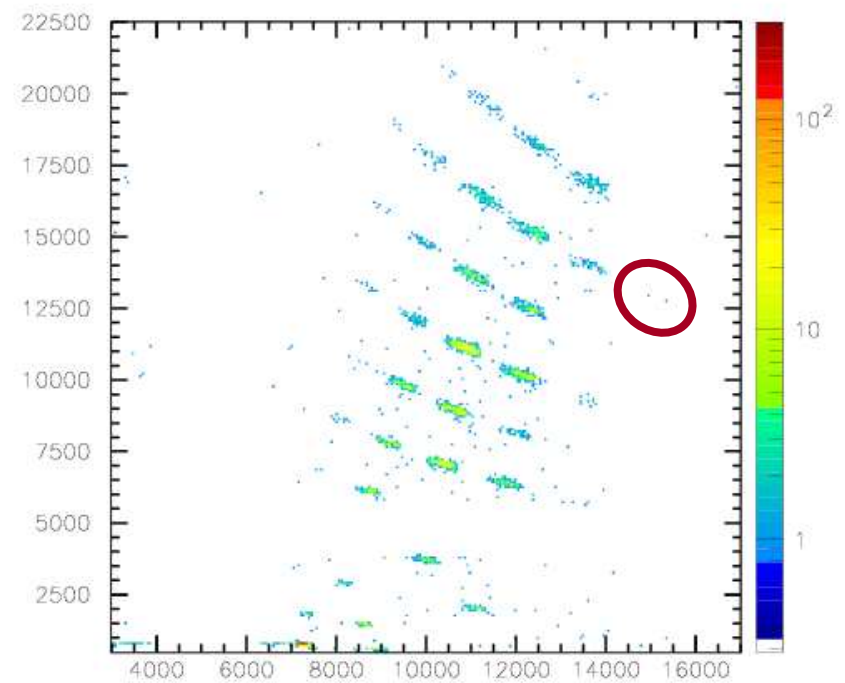
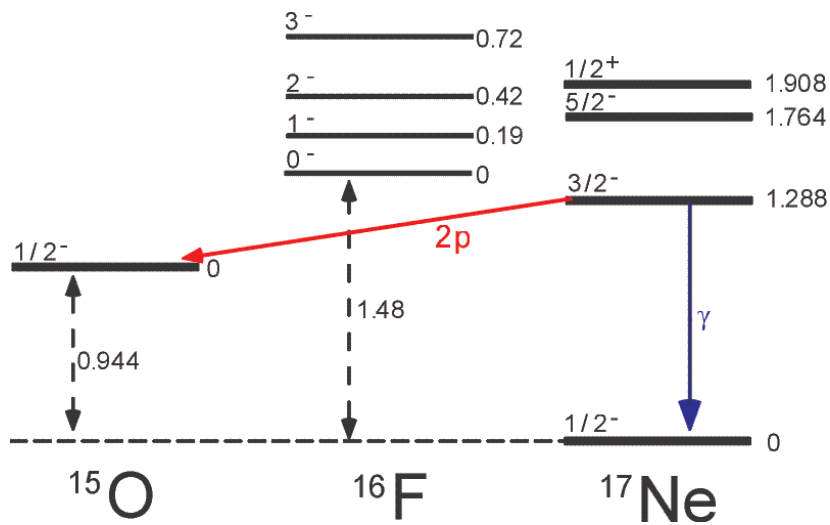
- @ Systematic investigation of 2p radioactivity in Be, C and O nuclei

What we would like to do....

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HUPPY: ^{17}Ne



Already searched for ^{17}Ne ...

Too low production rate

⌘ x10 factor needed

👉 CAN BE DONE!

What we would like to do....

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HUPPY: ^{19}Mg

$^{24}\text{Mg} + ^9\text{Be} \rightarrow ^{20}\text{Mg}$ (x10 factor $\approx 10^3$ pps)

► Primary ^{24}Mg production at high intensity to be investigated

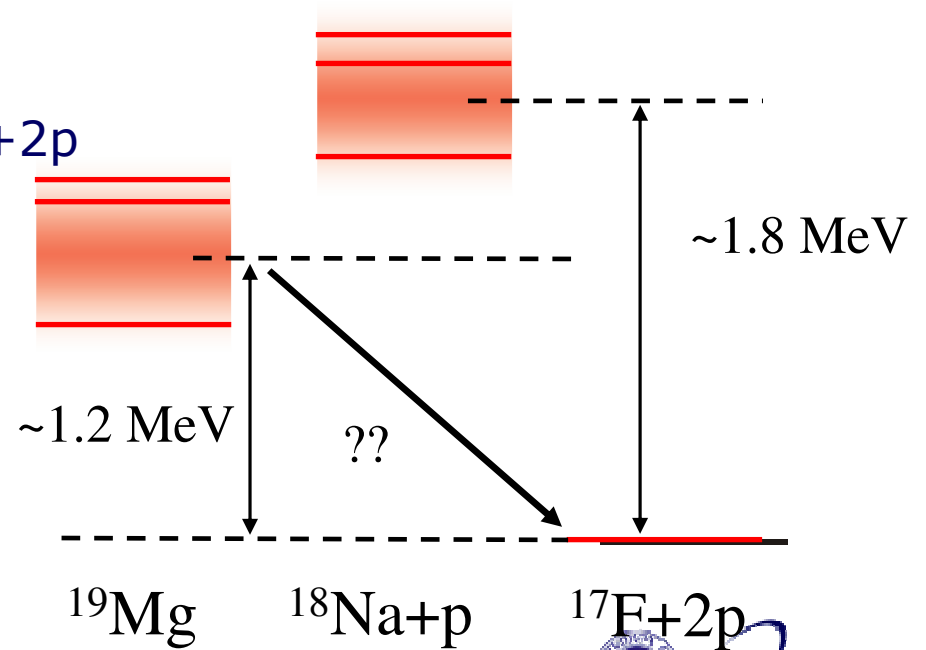
🤔 COULD BE DONE

► Knockout: $^{19}\text{Mg} \rightarrow ^{17}\text{Ne} + 2p$

$^{17}\text{Ne} \rightarrow ^{16}\text{Ne}: ^{16}\text{Ne} \rightarrow ^{14}\text{O} + 2p$

Fragment.: $^{20}\text{Mg} \rightarrow ^{18}\text{Ne} + 2p$

$^{17}\text{Ne} \rightarrow ^{15}\text{O} + 2p$



What we would like to do....

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